ANNEX 28

Initial 34

CLAIMS

1. Apparatus for a drill bit which is suitable for use in drilling, coring or removing material from a geological subsurface formation, which apparatus comprises a first member (21) for attachment directly or indirectly to a drill string, and a second member (22) carrying or constituting at least one means for drilling (23), said first member (21) being in torque and weight transmitting relation with said second member (22) and elastically or resiliently deformable connecting means (25) being provided between said first and second members (21,22) to allow said first and second members (21,22) to be tilted with respect to one another, characterized in that said second member (22) is connected by said connecting means (25) to said first member (21) in a free floating relation thereto allowing said second member (22) to tilt and move laterally with respect to said first member (21) solely in response to reaction forces experienced, in use, by said drilling means (23).

2. Apparatus according to Claim 1, in the form of a sub-assembly (2001,2002) for incorporation within a drill bit.

3. Apparatus according to Claim 2, wherein a drill bit body (2020) is integral with the second member (2002) with said first member (2001) constituting a drive shank of the drill bit.

4. Apparatus according to Claim 1, wherein said first member (21) constitutes the shank of a drill bit, and said second member (22) constitutes a drill bit body which carries at least one means (23) for drilling.

5. Apparatus according to any one of Claims 1 - 4, including means (46) for holding said first and second members

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(41,42) together and for transferring torque and weight from said first to said second member.

6. Apparatus according to Claim 1, wherein said second member (32) is tiltable or laterally movable with respect to said first member (31) against elastically or resiliently compressible means (35) between said first and second members.

7. Apparatus according to Claim 1 wherein said first and second members (41,42) have a cooperating passage (412) therein.

8. Apparatus according to Claim 7 which comprises compressible sealing means (45) between said first and second members to prevent escape of fluid from said passage (412) between said members.

9. Apparatus according to Claim 5 wherein said holding means and torque transfer means together comprise at least one elongate member (36) passing through said second member (32) and engaging in at least one recess or slot (37) in said first member (31).

10. Apparatus according to Claim 5 wherein said torque transfer means comprises grooves or recesses (617) in one of said first and second member (61,62) engaging corresponding gear components (618) in the other of said first and second members.

11. Apparatus according to Claim 10 wherein said holding means comprises a threaded locking ring (619) surrounding said first member (61) and engaging threads (620) on said second member (62).

12. Apparatus according to Claim 7 which comprises a first member having a first elongate conduit (812) therethrough cooperating with conduit means in said second

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member (82), said first conduit and said second conduit means being in fluid contact by way of a flexible pipe (825).

13. Apparatus according to Claim 7, wherein fluid passage means (3004,3005) is provided through said first member (3001), and wherein conduit extension means (3006) are provided at outlet ends of said fluid passage means (3005) on said first member to extend through said second member so as to discharge fluid below the second member without exerting a downward fluid force thereon.

14. Apparatus according to Claim 1 wherein said first member constitutes a drill bit body (112) and said second member constitutes at least one means (114) for cutting, which is carried by the drill bit body (112).

15. Apparatus according to Claim 14 wherein said cutting means comprises at least one cutter (114) which is tiltable with respect to said drill bit body (112).

16. Apparatus according to Claim 15 wherein said cutter (114) is adhered to said drill bit body (112) by an elastomeric spacer (113).

17. Apparatus according to Claim 15 wherein said cutter (124) comprises a stud, which is in a socket (1250) in said drill bit body with means (1259,1260) to restrain removal of said stud from said socket, and at least one spacer (1261) allowing tilting of said cutter with respect to said drill bit body.

18. Apparatus according to Claim 17 wherein said socket (1362) is in a separate member from said drill bit body (132), said member itself being in a hole (1363) in said drill bit body (132).

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19. Apparatus according to Claim 17 wherein said restraining means comprises an elastomeric stud catcher (1463) in a socket (1450) which is of outwardly decreasing diameter.

20. Apparatus according to Claim 6 or Claim 8 wherein said compressible means comprises an elastomeric spacer (35,45) between at least part of said first and second members (31,32; 41,42).

21. Apparatus according to Claim 20 wherein said elastomer is at least one of a hydrogenated nitrile rubber, a nitrile rubber and a polyurethane, and has a Shore A hardness of at least 80.

22. Apparatus according to Claim 20 wherein said spacer comprises an elastomer derived from a settable liquid set in situ.

23. Apparatus according to Claim 20 wherein said spacer is a preformed ring or gasket.

24. Apparatus according to Claim 20 wherein said spacer is a layered body with at least one layer of elastomer and at least one layer of metal.

25. Apparatus according to Claim 16 or Claim 20 wherein said spacer is at least 0.3 mm thick.

26. Apparatus according to Claim 6 or Claim 8 wherein said compressible means comprises a hollow body (932) adapted to contain a compressible fluid.

27. Apparatus according to Claim 26 wherein said compressible means (932) is adapted to provide torque transfer means between said first and second members (91,92).

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~~28. Apparatus according to any one of Claims 1 - 4 or~~ Claim 13 wherein said second member is tiltable relative to said first member against a hollow cylinder or spring.

29. Apparatus according to Claim 1 wherein said means (25) is adapted to allow tilting of up to 15 degrees.

30. A drill bit including apparatus according to any one of Claims 1 - 5 or Claim 14.

31. A drill bit including at least one apparatus according to any one of Claims 2 - 4 together with an apparatus according to Claim 14.

32. A sub-assembly for incorporation in a drill string, said sub-assembly comprising a first member (2001) and a second member (2002) each for torque transmitting attachment to respective elements of the drill string to provide a rotary drive connection between those elements of the drill string, means (2007,2013,2014,2017) for transmitting weight and torque between the first and second members (2001,2002), and connecting means (2004,2005,2016) between said first and second members (2001,2002) allowing said first and second members to be tilted with respect to one another, characterized in that said second member (2002) is connected to said first member (2001) in a free floating relation thereto by elastically or resiliently deformable connecting means (2004,2005,2016) allowing said second member (2002) to tilt and move laterally with respect to said first member (2001) solely under an applied load to a drill bit driven, in use, by said drill string.

33. A sub-assembly according to Claim 32 wherein said weight and torque transmitting means including a series of radial teeth (2013) on said first member (2001) which loosely engage in corresponding recesses (2014) in said second member (2002), with the radially outer surfaces (2016) of the teeth

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(2013) and the opposed base surfaces of the recesses (2014) being shaped to allow said relative tilting or lateral movement of said first and second members (2001,2002).

34. A sub-assembly according to Claim 32 wherein said second member (2021) is formed with connector means (2021) for attachment thereto of a shank (2023) of a drill bit (2022).

35. A drill string including at least one sub-assembly according to any one of Claims 32 - 34.

36. The combination of a drill string according to Claim 35 and a drill bit, wherein at least one sub-assembly is disposed at a position spaced at a distance above the drill bit (2020).

37. The combination of a drill string according to Claim 35 and a drill bit according to Claim 30 or Claim 31.

38. A method of drilling, coring or removing material from a geological subsurface formation using a drill bit according to Claim 30 or Claim 31, or a drill string according to Claim 35 or a combination of a drill string and a drill bit according to Claim 36 or Claim 37.

39. An apparatus for simulating drilling which comprises (a) at least one rigid rotatable body (192) connected directly or indirectly to (b) a drill bit (195) for contacting a simulated bottom hole surface, and (c) means (191) for rotating said body and bit, wherein at least one of (a) and (b), and (a) and (c), is separated by a flexible connector (b), and (a) and (c), is separated by a flexible connector (194).

40. An apparatus according to Claim 39 which comprises at least two rigid bodies (a) (192,193) spaced from one another and from (b) and (c) by flexible connectors (194).

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41. An apparatus according to Claim 39 wherein said body (a) (192) is a rigid cylinder threaded to a correspondingly threaded flexible connector (194).

42. An apparatus according to Claim 39 wherein said flexible connector comprises two plates each carrying a thread adapted to engage a rigid cylinder, said plates being separated by a flexible member.

43. An apparatus according to Claim 39 which also comprises a simulated bore hole comprising at least one bore member having a bore in which said rigid body (192) can rotate.

44. An apparatus according to Claim 39 which has one of its natural frequencies not greater than 10 Hz, preferably not greater than 1 Hz.

45. An apparatus according to Claim 39 which comprises an axial passage through all of said rotatable bodies (192,193), flexible connectors (194) and the drill bit (195).

46. A method of simulating downhole drilling conditions of a specific downhole location utilizing an apparatus according to Claim 39, including testing scale versions of downhole equipment to be used at said downhole location in said apparatus and altering the design of the equipment as necessary, in order to reach an optimized design of such equipment, and using the optimized design for the corresponding equipment to be used in practice at said downhole location.

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